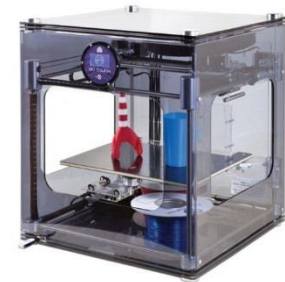
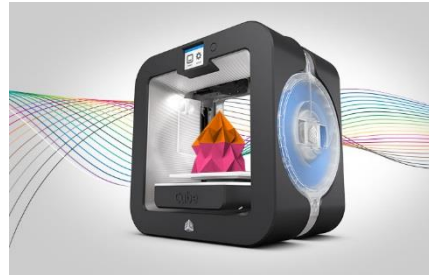


3D Printer Infrastructures for Academic Institutions From Zero to Hero



Presented by: Ray Uzwyshyn, Ph.D. MBA MLIS
Director, Collections and Digital Services, Texas State University

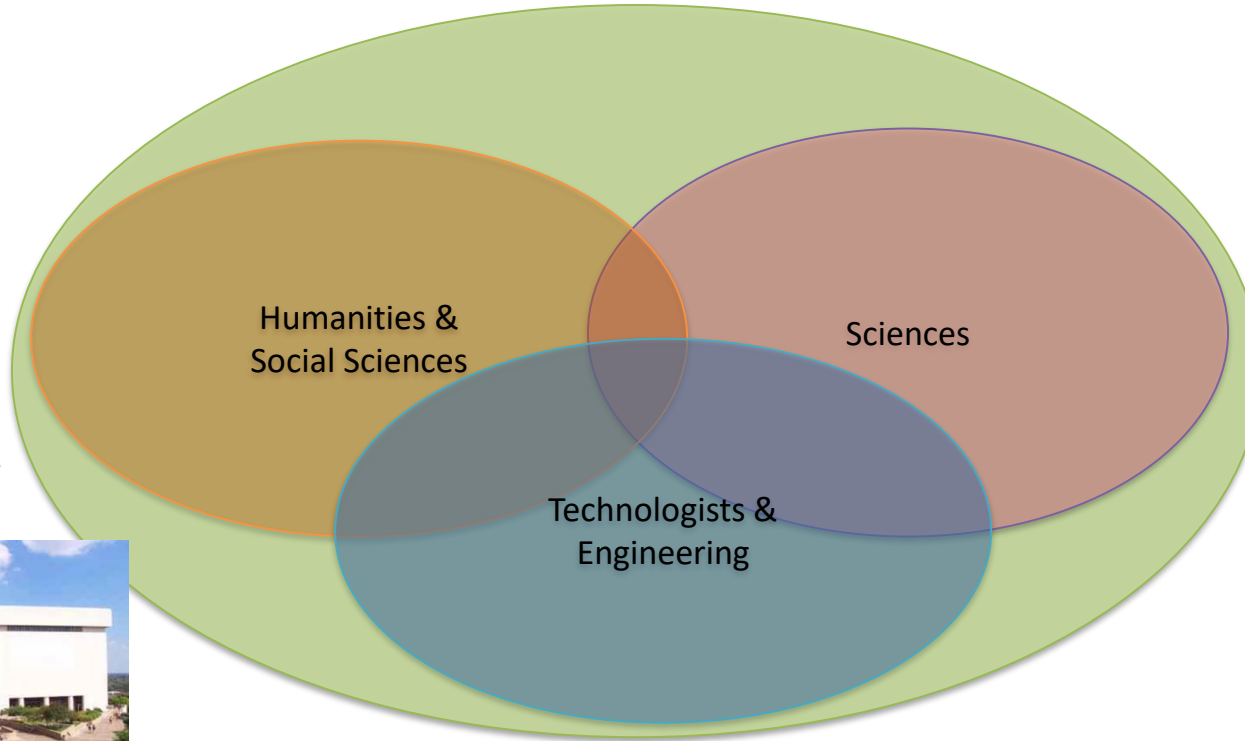
October 2014 Prototype 3D Printing Lab

for Texas State University Library Learning Commons Proposed

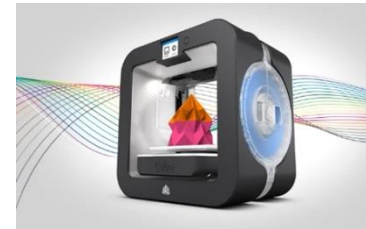


LARGER RATIONALES

1. Collaboration
2. Third Space for Learning.
3. Cross fertilization of Projects, People and Skillsets.
4. Interdisciplinarity



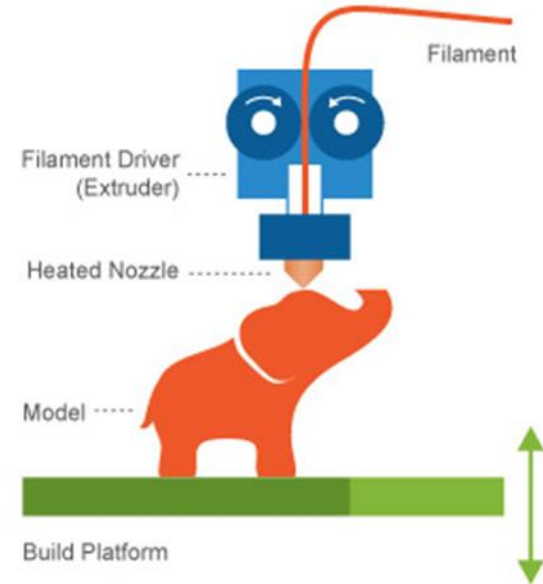
[Overview Video](#)



Getting Started

Background Overview

- **Environmental Scan (Nov – Jan 2015)**
Environmental Scan on TXU Campus. Current 3D Printer Landscape, Scenarios, Needs Assessment Conducted



[3D Printing Overview](#)

Environmental Scan

Background Scenarios

Six Areas Visited on Campus December 2014 – January 2015, Four with 3D Printers ranging in size from a couple hundred dollars to half million dollar set ups, two others areas wishing to explore this technology further:

- 1) Educational Technology
 - 2) Art & Design
 - 3) Engineering/Engineering Technology
 - 4) Forensic Anthropology
-
- 1) Geography
 - 2) STEM Education

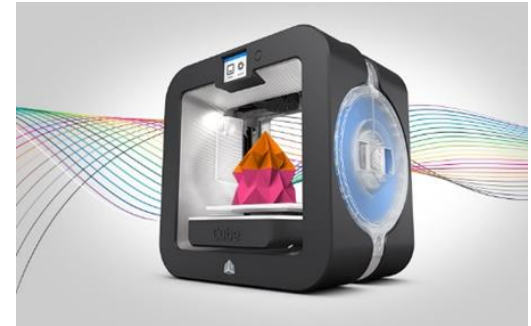


Full Report: <http://tinyurl.com/mgkkc6e>

3D Printer Parameters Generated (From Environmental Scan)

Parameters

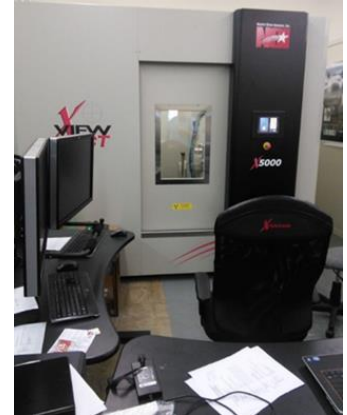
- Speed of Printing
- Resolution (How finely the printer prints)
- Cost (Budgetary implications)
- Safety (Biodegradable Filament, APL, Ventilation)
- Congruence with other University/Library Setups



Approvals and Subgroups

Approval and Funding (February 2015)

Environmental Scan Presented to VPIT/Learning Commons Committee. Approval given the library/project to move forward with 3D Printer Infrastructure from environmental scan results.



Subgroups (April, 2015)

Two subgroups formed

- 1) 3D Printer Selection Subcommittee
- 2) 3D Printer Infrastructure Policy Committee

3D Printer Subcommittees Charges

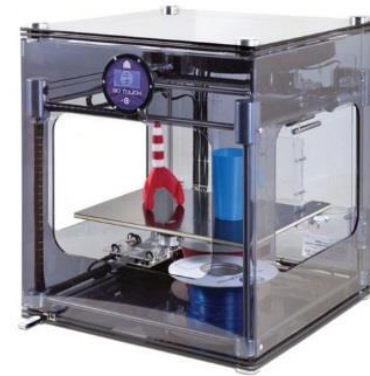
- **3D Printer Selection Subcommittee:**
Recommend 3D printer, surrounding equipment, possibly 3D scanner, software, filament
- **3D Printer Policy Infrastructure Subcommittee:** Develop policies, procedures, library space allocation and human resource infrastructure recommendations



3D Printer Selection Preliminary Caveats

Requirements

- Budget (15 – 50 K range)
- 1 3D Printer/1 extra Extruder
- 1 3D Scanner
- Filament/Software
- 5-10k 3D Printer Desired (**Scenario Constituents**)
- Safety (Biodegradable Plastic, APL, No hood)
- Preferred Congruence with other Universities



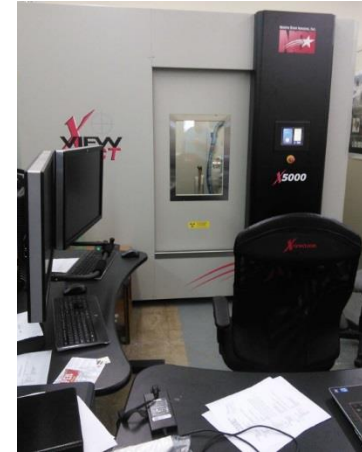
TXU 3D Printer Landscape



Low End – Education
< \$ 2000.00 – [Primarily Geared to Future K-12 Teachers](#)



High End – Forensic Anthropology,
~\$ 1,500,000.00 Set-up
(800,000.00 Scanner)



Very High End

Stratasys multi-material full color 3D Printer Objet500 Connex3



**\$330,000.00 (Star Park, Science Technology Applied Research Park Set-up
(Other Additions Here include Laser Cutter and 3D Scanner Set-ups)**

Closest TXU Learning Commons Analogue

Art & Design Lab



Makerbot Replicator

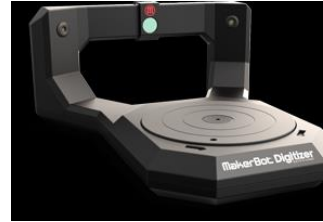
3000.00

Software:

Rhino (25 Copies, 119

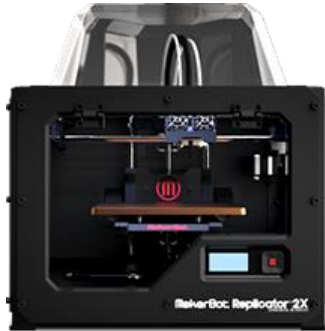
Alkek)

Sketchup



**Makerbot
3D Scanner**

800.00



Makerbot Replicator

2X (Double Headed
Extruder)



Filament

Two Staff

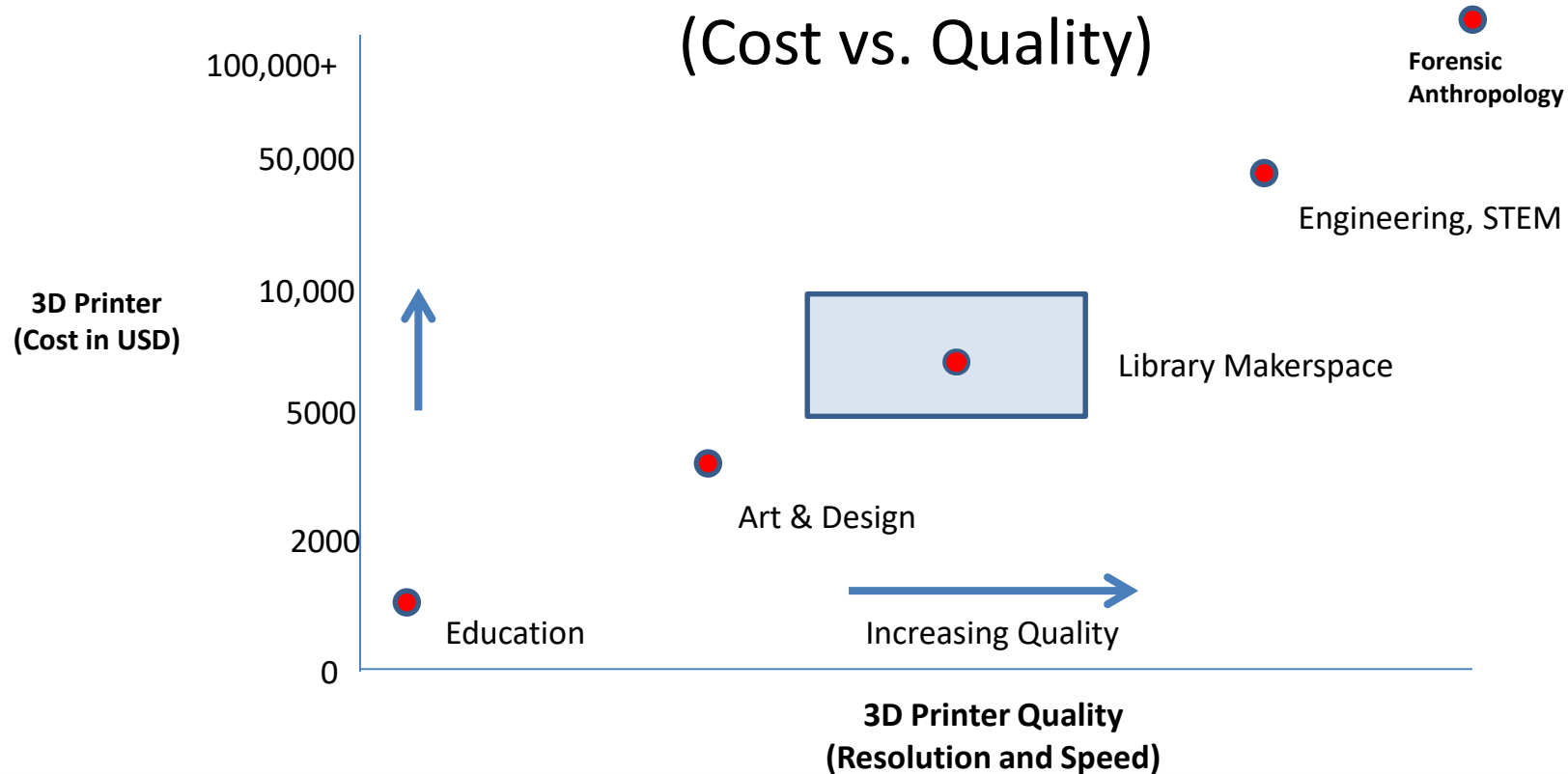
Hands Off Example: UT Austin Innovation Station



- [Makerbot Vending Machine Innovation Station Video](#)

TXU 3D Printing Landscape

(Cost vs. Quality)



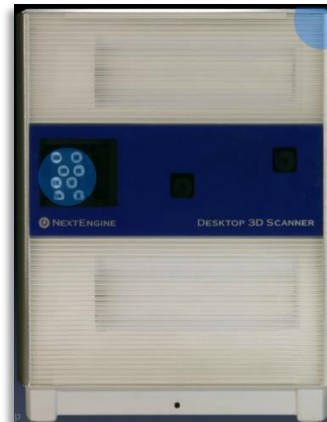
Subgroup Recommendation for 3D Printer Set-up

May 2015



Makerbot Replicator Z18

Makerbot Replicator Z18	\$ 5,602.54
Makerbot Cart	964.87 Extra
Extruder (Print Head)	172.92
2 Year Protection Plan	1,224.40
Subtotal:	\$7964.73



2 Repurposed Computers	\$0.00
Next Engine 3D Scanner	2,795.00
3D Scanner 3 Year Extended Warranty	295.00
<u>Next Engine MultiDrive</u>	895.00
HD Pro Scanner Software	995.00
20 Spools of Filament	267.12
Sketchup Pro – 2015 (Commercial)	590.00
1 Rhino 3D License	799.00
LC 1200 Line Conditioner	125.00
Subtotal:	\$6771.12

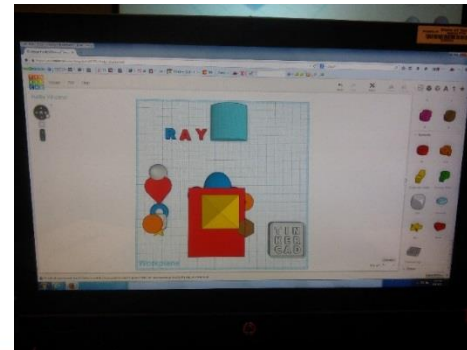
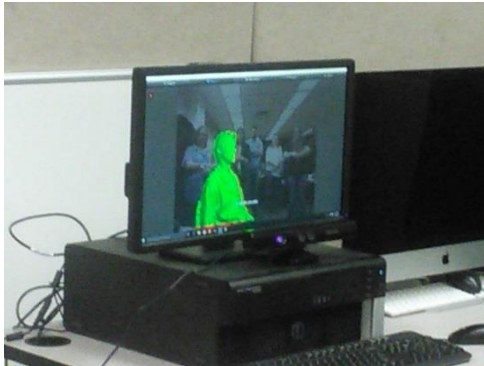
Grand Total (Est): \$14,725.85

Agile Development Cycles

- **Purchase & Set-up**
Printer/Equipment/Supplies
June-August 2015 (3 Months)
- **Staff Training**
Soft Launch of New 3D Printing Service
Sept. – Dec. 2015 (4 months)
- **Official Launch & Marketing**
January - May 2016 (4 months)



Initial Lab Set-up



Alkek 3D Printing Service Page/FAQ

3D Printing at Alkek Library

What is 3D printing?

3D printing is a process by which a design that began as an electronic file is rendered as tangible, three-dimensional object. There are many methods, but our process involves super-heating filament (in our case, PLA) and extruding it one layer at a time into the form created by the file. 3D printed objects can have moving parts, can be sized, or can be created to be assembled later. Any object that can be designed can be printed, so long it doesn't violate our terms of use, or isn't too large for the build platform.



[Expand](#) or [Collapse](#) all.

Who can use the 3D Printing service?

What material is used in 3D Printing?

How long does it take to print something?

How is the cost determined?

<http://tinyurl.com/zx6sqon>

3D Printing Remote Service Form

3D Printing Order Form

Alkek Library now offers 3D printing to customers.

To get started, fill out the form below. After we receive your request, you will be with a time and cost estimate. Once complete, objects can be picked up from the desk on the second floor of Alkek Library.

Name *

Net ID *

Date Submitted *

Date Needed. Workload or project size may delay your completion date. *

<http://tinyurl.com/gwk3cjin>

3D Printer Service Set-up Example

Date: ____/____/____

Name: _____

Email: _____ / Phone: _____

2D _____

EPSON STYLUS PRO 3880

Size	Quantity	TOTAL
<input type="checkbox"/> 8.5x11	_____ x \$1.50 (Image fits in a 4.25 x 4.25 box)	\$ _____
<input type="checkbox"/> 8.5x11	_____ x \$3.00	\$ _____
<input type="checkbox"/> 13x19	_____ x \$7.00	\$ _____
<input type="checkbox"/>	\$3.50/paper supplied*	\$ _____

*paper supplied must be an Epson Matte Inkjet Paper

Second side print: Charge for cost of front and 1/2 cost for back: _____ \$

EPSON STYLUS PRO 7800

☐ 24x _____ = _____ x \$0.04 per square inch _____ \$

Calculate as follows: 24 inches x the height of the file + 1 inch x \$0.04
 <Example for a 16x20 print: 17 in x 24 in x \$0.04 = \$16.32>

Paper Type _____ **Crop Marks?** _____

_____ 8.5x11 Singleweight Matte
 _____ 8.5x11 Heavyweight Matte
 _____ 13x19 Singleweight Matte
 _____ Epson 7800: Doubleweight Matte only

TOTAL \$ _____

GRAND TOTAL \$ _____

2D Comments/Instructions _____

File Name/s: _____

Receipt of Prints Signature _____

Amount remaining in account: _____

Date: ____/____/____

Name: _____

Email: _____ / Phone: _____

3D _____

1. SET-UP _____.stl format / _____.obj format / _____.thing format
within 10 minutes*, print ready for extruding single/\$1; dual/\$5 _____ \$

*additional time: \$3.00 per 15 minutes for custom adjustments: _____ \$

2. MATERIALS

_____ grams x _____ cost of spool* + 1000 ft roll _____ \$

_____ * \$50.00 PLA Natural Color
 _____ * \$55.00 PLA True Colors: ____Red____Purple____Blue____Yellow____Orange____Black____White
 _____ * \$70.00 PLA Translucent Colors: ____Red____Purple____Blue____Yellow____Orange____Green
 _____ * \$140.00 PLA Glow in the Dark

_____ * \$50.00 ABS Natural Color
 _____ * \$55.00 ABS True Colors: ____Red____Purple____Blue____Yellow____Orange____Black____White____Gray____Green
 _____ * \$70.00 Dissolvable

3. PROCESS

_____ minutes run time x \$0.15 cost/minute _____ \$

TOTAL \$ _____

3D Comments/Instructions _____

File Name/s: _____

Receipt of Work Signature _____

Amount remaining in Account: _____

3D Printer Service Policy Example

ADRC Print Center

JCMitte Building, Room 3102A
512-245-8470

The Print Center is a service bureau for Art and Design faculty and students.

Payment

- Try to predict how much printing you will need for a project or for the semester.
- Students must pre-pay for prints at the JCK cashier's window (cash only).
- Bring your receipt back to the ADRC and they will set up your account.
- A record of your balance will be kept at the Center.
- Faculty who wish to use the Print Center must make arrangements with the School Director.

Printing your documents

- The Print Center staff will not prepare or edit your files for you.
- They will not rasterize or outline your type.
- Any file presented in a PDF format will be printed from Photoshop.
- Our Epson printers are set up in sRGB. The printers are set to print from this profile using the papers we carry.

Printing Options

EPSON R3880
8.5" x 11" \$3.00 Premium Presentation Paper (Matte)
\$1.50 if you provide paper, Epson Inkjet (Matte) only

13" x 19" \$7.00 Premium Presentation Paper (Matte)
\$3.50 if you provide paper, Epson Inkjet (Matte) only

EPSON STYLUS PRO 7800 (*for oversized printing*)
Doubleweight Matte paper only, \$.04 per square inch, provide borders on all sides.
Example: One 16" x 20" print would be calculated as: 17" x 24" x \$.04 = \$16.32

- For best results on the 7800, use Photoshop files.
- Export InDesign or Illustrator files as a Photoshop EPS and open them in Photoshop to rasterize them.
- Drag the file to a 24-inch wide Photoshop document using the height of your file plus 1 inch.
- Leave a .5 inch border at top and bottom of your image and 1 inch on the sides.
- Save as a TIFF or PSD.

In all cases, you will get the best color results by exporting your files from InDesign or Illustrator and printing from Photoshop in RGB.

File transfer options

- Flash Drive
- CD/DVD
- Drop Box

To access the ADRC_Print Server drop box from a Mac in the Mitte building, follow this path:

Desktop > Go > Network > ADRC_prints here > Connect as >
name - artuser / **password** - print > Connect > artuser > Public > Drop Box

Naming Files

Label files with last name and date e.g., *picasso_10_28_15.psd*

A work order form will need to be filled out with the details of the print job.
See other side of sheet for pre-payment procedures.

Production Notes

- Depending on time work is submitted and the actual time needed to process work, please preplan as we can not guarantee same day work. It is helpful to speak with us for a realistic turnaround on your project.
- Finished work will be ready for pickup at the ADRC front counter.

ADRC

Art & Design Resource Center

Operating Hours

Monday - Thursday	8 am - 10 pm
Friday	8 am - 4 pm
Sunday	4 pm - 8 pm

ADRC Telephone Contact

512-245- 8470

3D Model Software

- **Rhino**
- **Sketchup 3d**
(Free & Conversion)
- **Autodesk123D**
(Free 3D Toolset/
Scanning Software)
- **Other Services**
Shapeways.com



123D Catch

Generate 3D models from
photos



123D Circuits

Design your next electronic
project



123D Design Updated!

Easy 3D modeling for Mac and
PC



123D Make

Unique 3D models from 2D
slices



123D Sculpt+

Create 3D sculptures on iPad

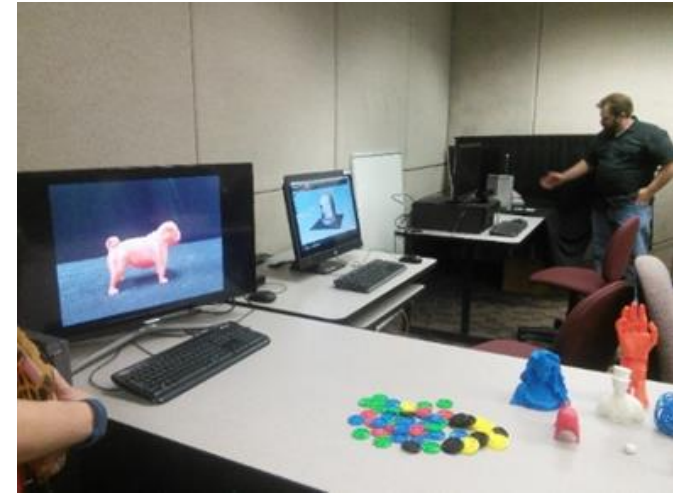


Tinkercad

Get started with 3D modeling

Room Space/Product Dimensions Considerations

- Printer Dimensions: 49.3 L x 56.5 W x 86.1 H [19.4 W x 22.2 D x 33.9 H IN]
- 2 Tables – 6 ft x 3 ft. Computer Tables
- 2 Small Tables – 4ft x 3ft. Separate Scanning Table
- Extra Computers
- Ventilation

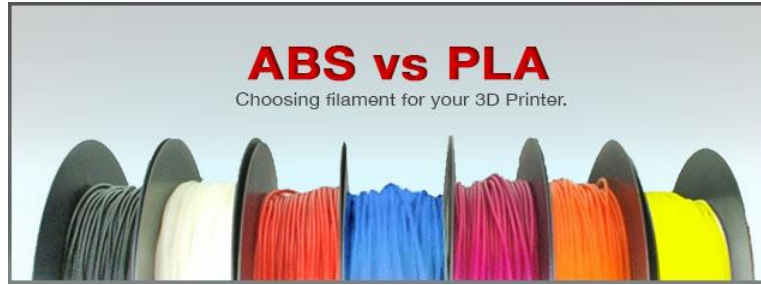


Ventilation

ABS vs. PLA Filament



Safety Considerations



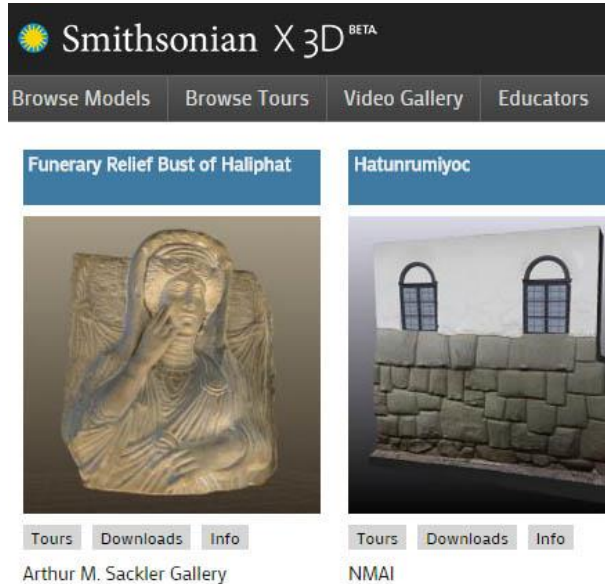
- ABS – Acrylonitrile Butadiene Styrene, Hot Plastic (Oil/Petroleum Based)
- PLA, Poly Lactic Acid
Biodegradable, **Plant-Based**, corn, potato, sugar-beet derived, eco-friendly, Sugar smell

PLA vs ABS Comparisons

	PolyMax™ PLA	ABS
Printing temperature	Low (nozzle - 190-210 °C, heated plate - 60-70 °C)	High (nozzle - 230 °C, heated plate - 110 °C)
Tendency to warp	Almost warping-free	Tends to warp for larger parts
Health hazards during printing	Minimal (main degradation product is non-toxic lactic acid)	High (generates toxic gas and high concentrations of nanoparticle aerosols')
Dual-extrusion stability	Excellent	Good
Mechanical Properties	Excellent	Good

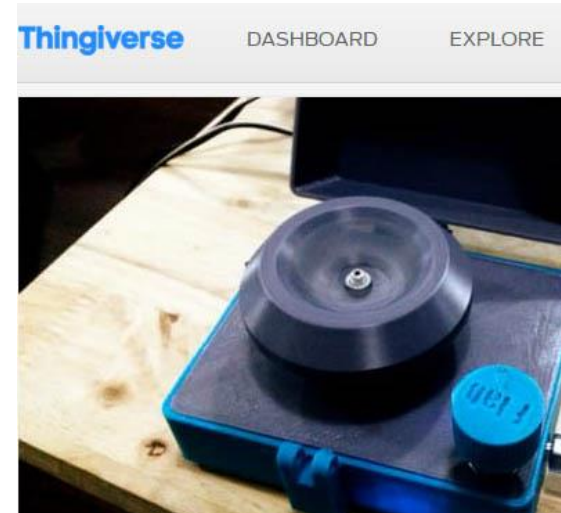
- PLA is Safer than ABS but ventilation is still recommended
- Good Study on “Ultrafine Particles and Potential Risks of 3D Printing (Molitch-Hou, 2013, Stephens, Azimi et al, 2013)

3D Resources



<http://3d.si.edu/>

[Educator video](#)



<https://www.thingiverse.com/>

[Thingiversity \(Educators\)](#)

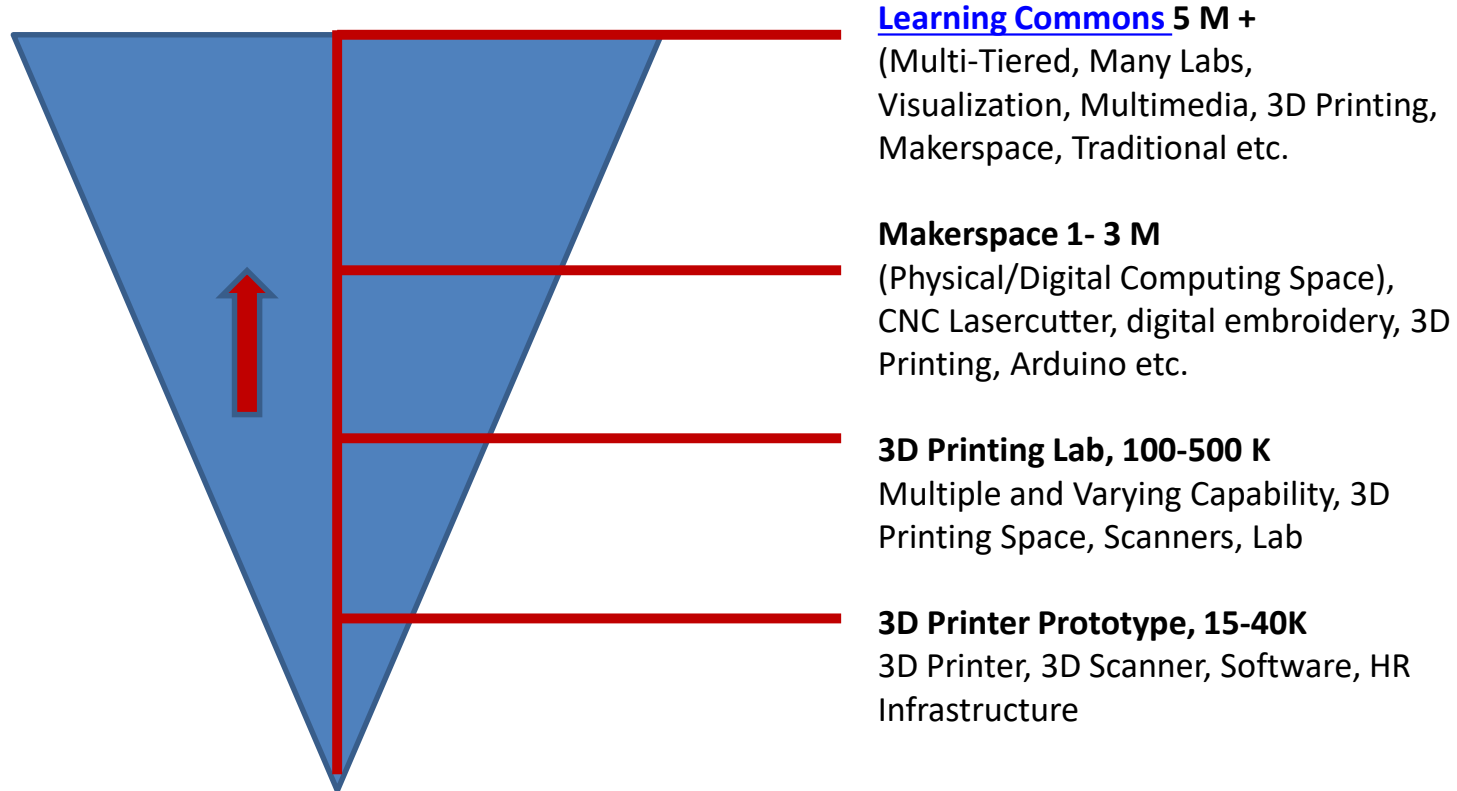
Next Steps:

Assessment & Evaluation, 3D Printer Lab Expansion



(3D Printer Lab Possibility)

Future Trajectories (Scaling)



Discussion and Questions

Contact Info

Ray Uzwyshyn, Ph.D. MBA MLIS

Director, Digital and Collections Services

Texas State University, R_U15@txstate.edu

<http://rayuzwyshyn.net>

Further Resources

(Special Thanks to Dr. Shaunna Smith,
Texas State University, for this list)

Access 3D Models

[Smithsonian X 3D](#) (3D scans of historical artifacts)

[Morphosource](#) (3D scans of skeletal remains)

[Digimorph](#) (3D scans of skeletal remains)

[NASA 3D Models](#) (3D scans of topography and aerospace equipment)

[Thingiverse](#) (downloadable 3D model files and open community sharing)

Learn more about ways to connect existing 3D models to teaching and learning [here](#).

Create Your Own 3D Models

[Autodesk 123d Website](#) (free, must set up account)

[Tinkercad App](#) (free, web-based app to create 3D models)

[Tinkercad “quest” lessons and video tutorials](#)

["3D Printing with Autodesk 123D, Tinkercad, and Makerbot" by Lydia Sloan Cline](#)

[“3D Modeling/Printing with Tinkercad: Create/Print3D Models. James Floyd Kelly”](#)

[Autodesk 123d Design](#) (free, downloadable software to create 3D models)

[Autodesk 123d Make](#) (free, slice 3D models into 2D puzzle pieces)

[Autodesk 123d Sculptplus](#) (free, manipulate digital clay on an iPad)

[Autodesk 123d Catch](#) (free, upload photos of objects to create 3D models)

Learn more about scanning your own 3D models [here](#).

Order a 3D Print from an Online Service or go to a Makerspace

[Shapeways](#) (online service, upload file and they mail print to you, lots of materials choices)

[3D Hubs](#) (online network of 3D printers in your community, upload file and pick it up at store)

Article

Uzwyshyn, R. [“One Size Does Not Fit All: Pragmatic Reflections on 3D Printers for Academic Learning Environments.”](#) *Computers in Libraries*. 35(10). December 2015. pp. 4-8.

